

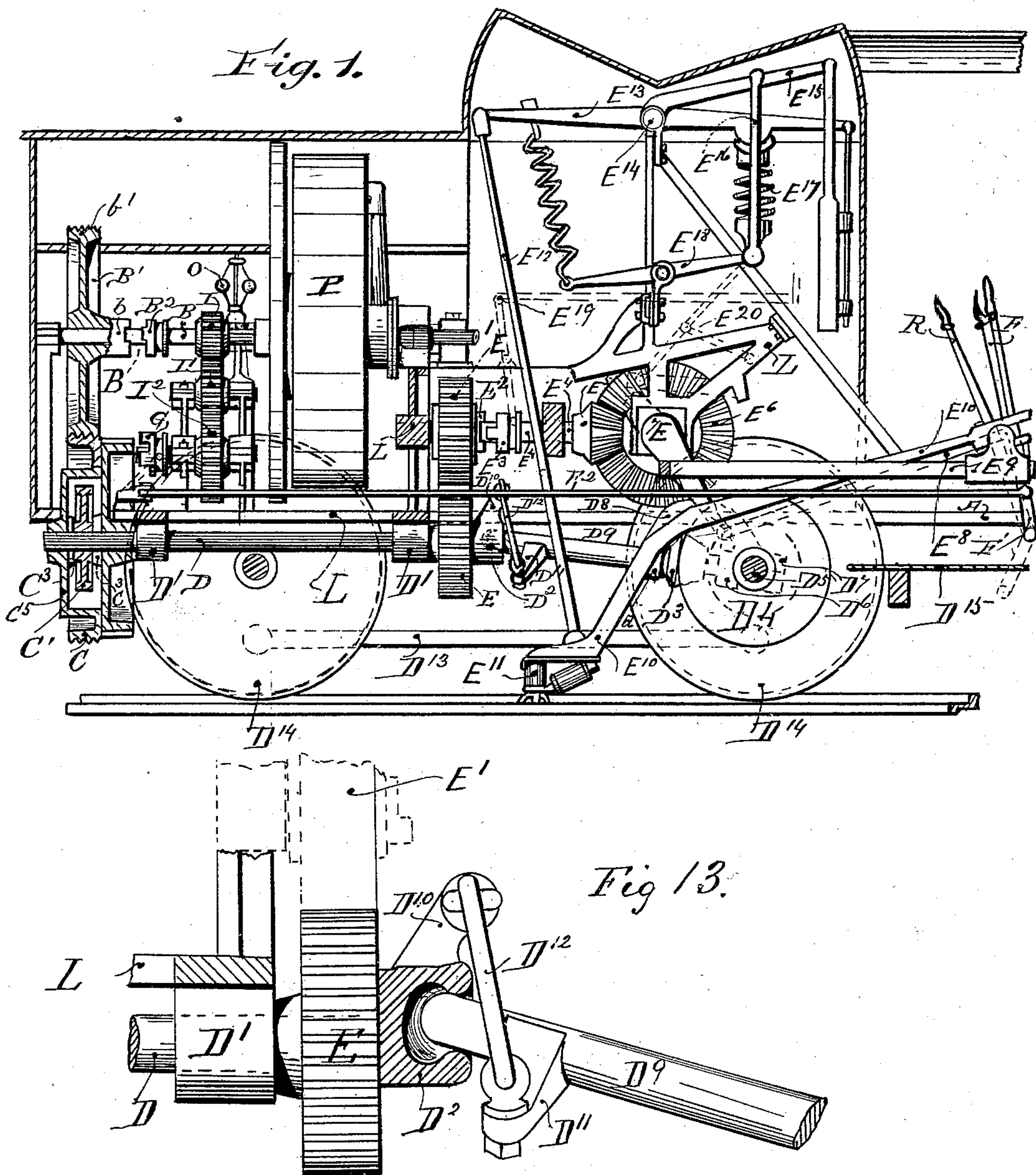
(No Model.)

4 Sheets—Sheet 1.

B. C. POLE.  
MOTOR FOR STREET RAILWAYS.

No. 401,855.

Patented Apr. 23, 1889.



WITNESSES,  
*Harry Boluer.*  
*H. J. England*

INVENTOR  
*Benjamin C. Pole*

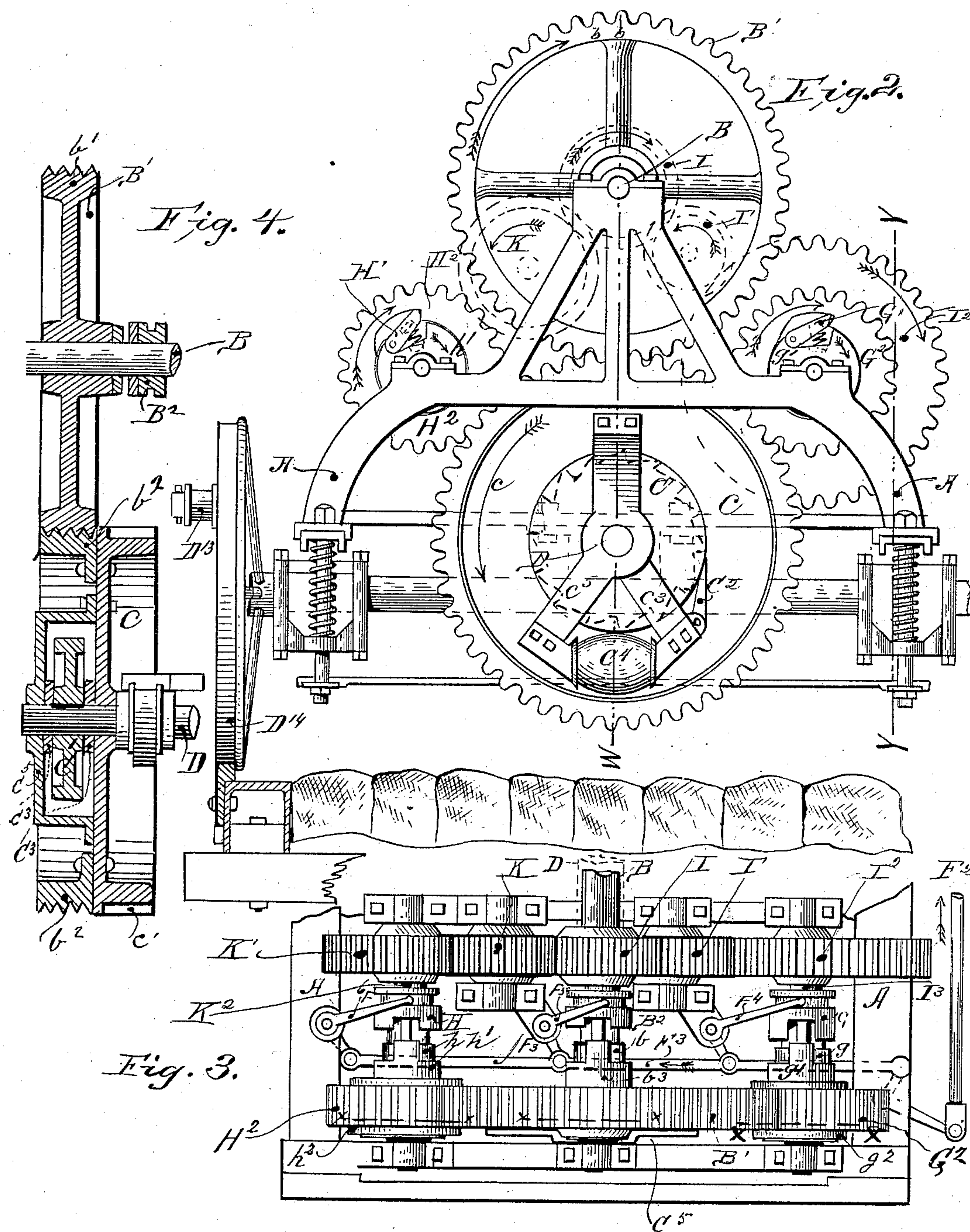
(No Model.)

4 Sheets—Sheet 2.

B. C. POLE.  
MOTOR FOR STREET RAILWAYS.

No. 401,855.

Patented Apr. 23, 1889.



WITNESSES,  
Harry Rohrer.  
H.T. England

INVENTOR  
Benjamin C. Pole



(No Model.)

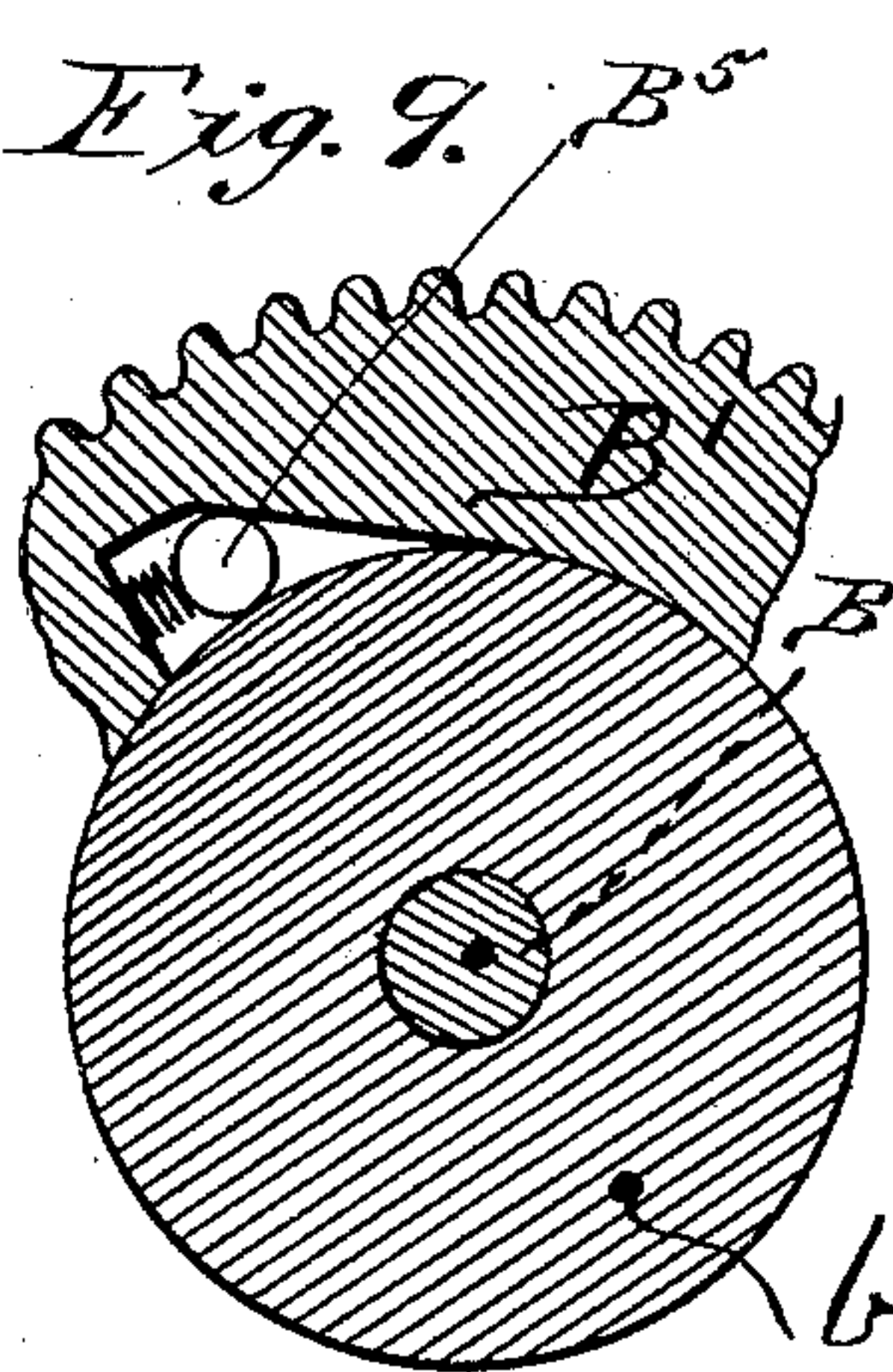
4 Sheets—Sheet 3

B. C. POLE.  
MOTOR FOR STREET RAILWAYS.

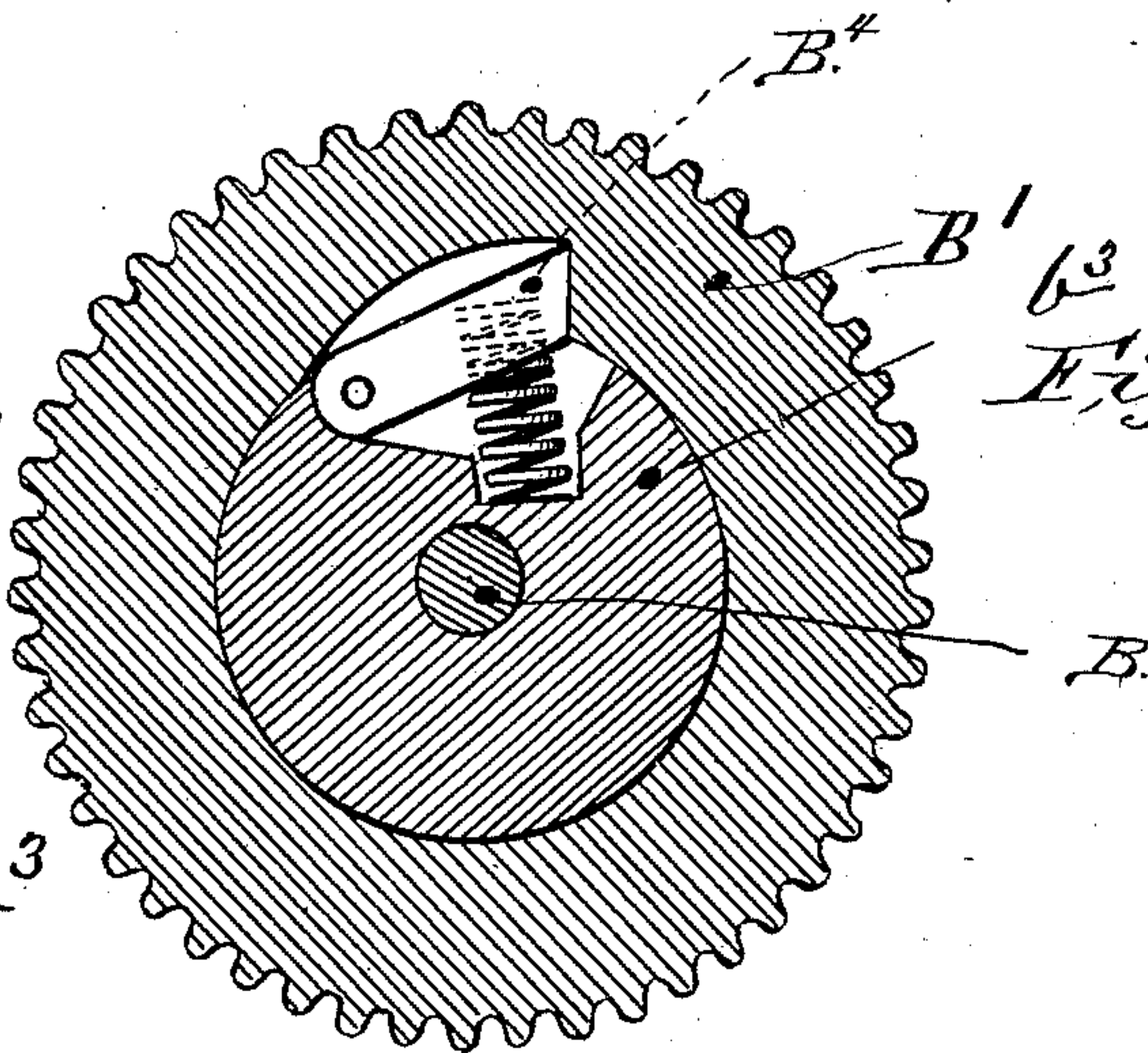
No. 401,855.

Patented Apr. 23, 1889.

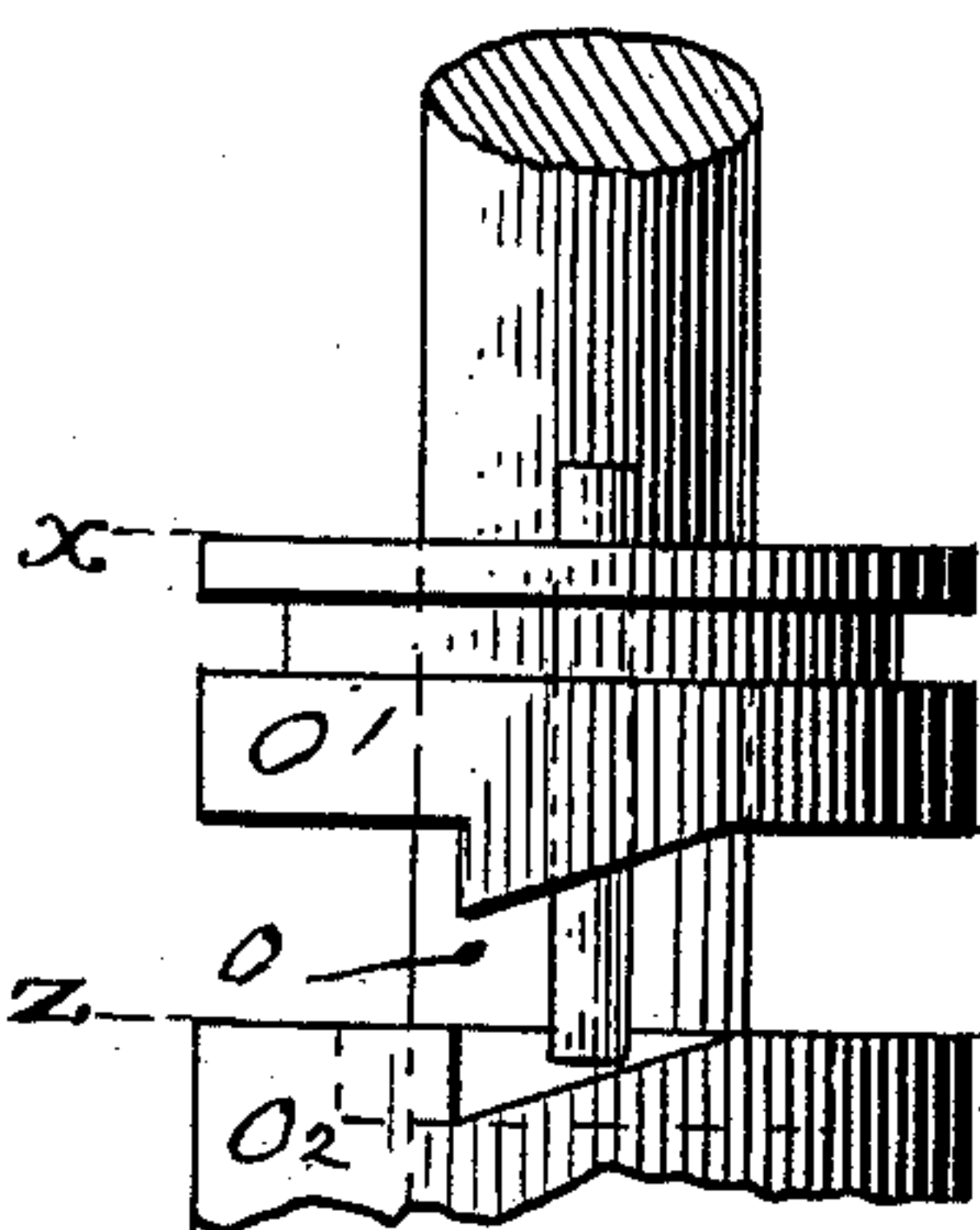
*Fig. 9.*



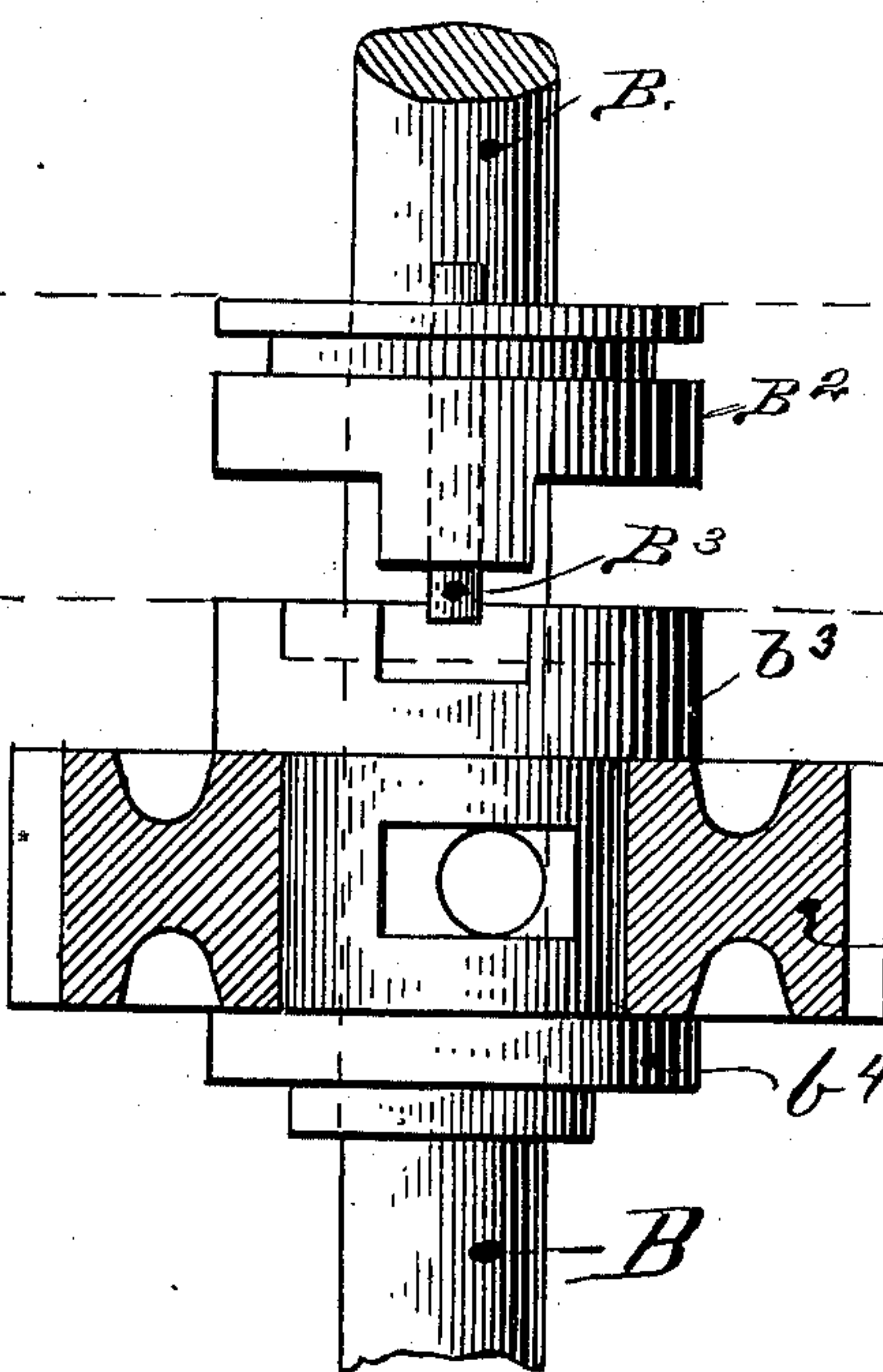
*B^4*



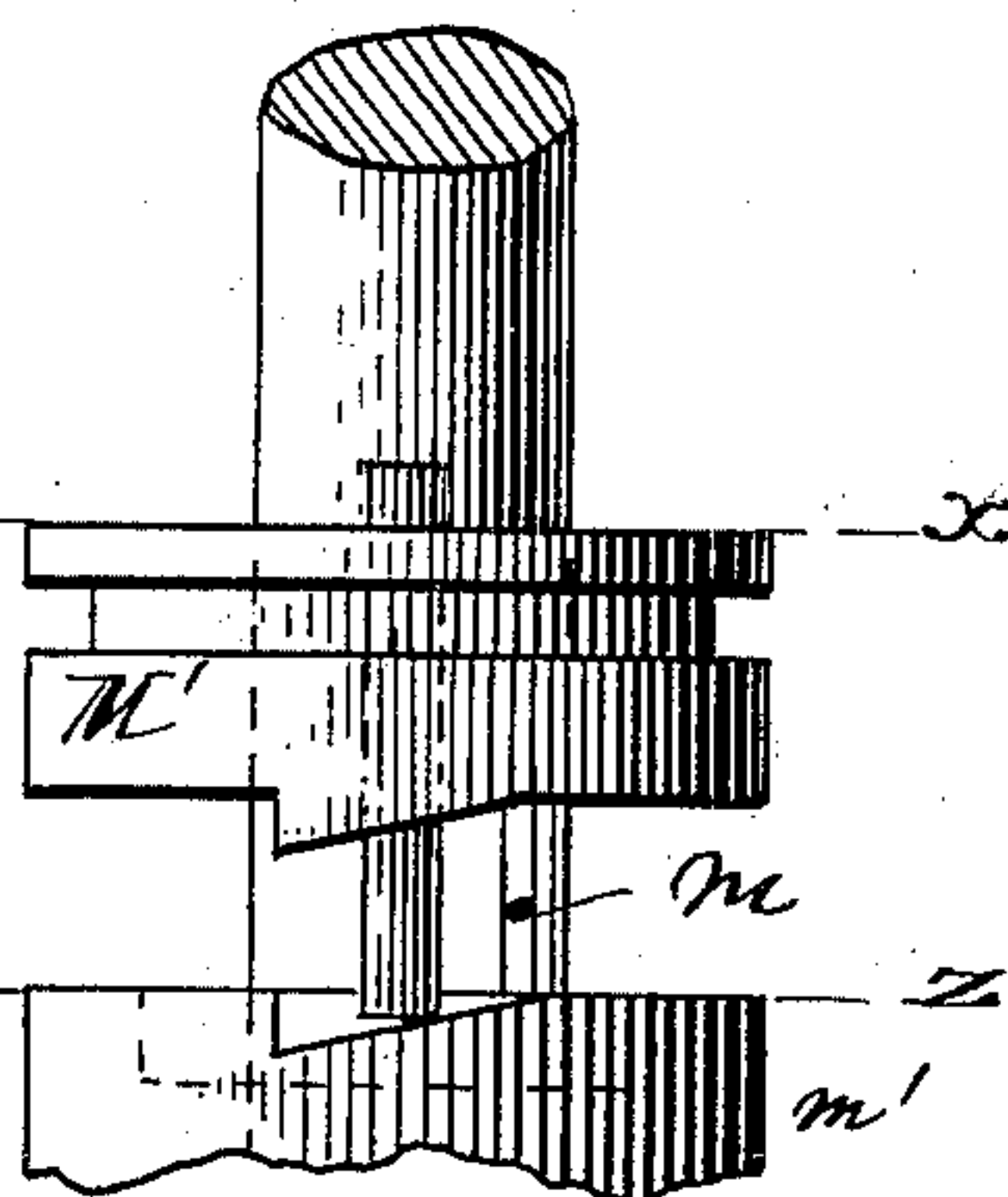
*Fig. 7.*



*Fig. 6.*



*Fig. 8.*



WITNESSES

*Harry Rohrer*  
*H. J. England*

INVENTOR

*Benjamin C. Pole*

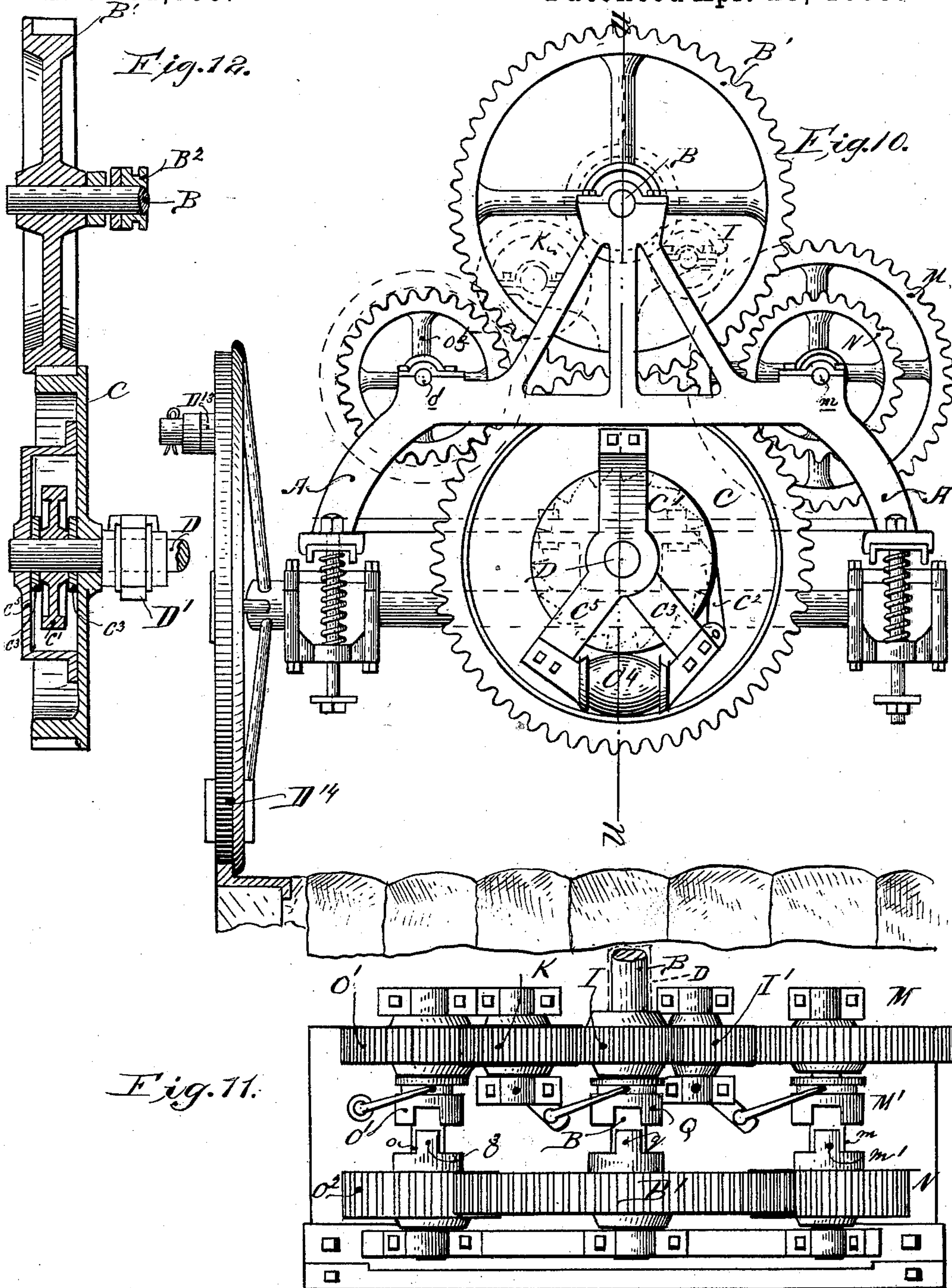
(No Model.)

4 Sheets—Sheet 4.

B. C. POLE.  
MOTOR FOR STREET RAILWAYS.

No. 401,855.

Patented Apr. 23, 1889.



WITNESSES:  
Harry Bohrer  
H. J. England

INVENTOR  
Benjamin C Pole



# UNITED STATES PATENT OFFICE.

BENJAMIN CHARLES POLE, OF CAMDEN, NEW JERSEY.

## MOTOR FOR STREET-RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 401,855, dated April 23, 1889.

Application filed August 24, 1886. Serial No. 211,756. (No model.)

*To all whom it may concern:*

Be it known that I, BENJAMIN CHARLES POLE, an engineer and a citizen of the United States, residing at Camden, in the county of Camden and State of New Jersey, have invented certain new and useful Improvements in Motors for Street-Railways; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to motors for street-railways; and it consists in certain improvements in the construction of the same, as hereinafter described and claimed. I provide a set of differential wheels with clutches and a pawl or a roller-stop; also an additional wheel, on the shaft of which are placed an adjacent ratchet-wheel and a yoke to which is secured a pawl. An arm which is made fast to said additional wheel incloses said ratchet-wheel and yoke, and a spring is placed between said arm and yoke, forming an elastic connection between said parts, as herein described and shown.

The object of this invention is to enable the operator or driver to make the changes of the operating-power for the purpose of traction by simply putting into gear the clutches without danger of locking the motor and tearing out the teeth. It is designed, however, to use a friction-brake upon the said motor.

Certain devices shown herein differ merely in form from those shown in Patents Nos. 365,273 and 381,847, said devices being only equivalents, as in the instance of the arm on the driving-axle provided with means for attachment and detachment, a similar device being herein shown with but one beveled pinion to operate two sliding pinions on the driving-axle for the purpose of reversing the motor. The shaft and arm, being relatively in diagonal positions, terminate at a universal-joint coupling. One lever serves to operate the motor and the clutch mechanism. An engine substantially of the construction described in Letters Patent No. 371,214 is employed.

Like letters indicate like parts in the several figures of the drawings, in which—

Figure 1 is a sectional side elevation of my improved motor, the rear part of said figure being taken on section-line W W of Fig. 2, and showing in section the additional wheel with the spring and the ratchet. A portion of this figure farther forward is shown in section taken on line Y Y of Fig. 2. Forward of this portion are shown the foot and its connecting-rods, its crank-axle and lifting devices, spring-beams, and pinion; also are shown in dotted lines the beveled pinion on the driving-axle and arm and the shaft which connects with the universal-joint coupling. Fig. 2 is a rear view of Fig. 1, showing the pinion-wheels forming the differential mechanism and the connection of the pawl with the said wheels and the wheel with the spring and the ratchet. Fig. 3 is a partial plan of Fig. 2, showing the position of the wheels which are at the rear part of the motor, forming a differential construction. Fig. 4 is an enlarged vertical section of the differential wheels and connections. Fig. 5 is a cross-section of the differential wheel and the ratchet, taken on line x x of Fig. 3. Fig. 6 shows in section the pinion-wheel which runs on the hub of the central differential wheel, the position of the space provided for the pawl or catch, as shown in Figs. 2, 5, and 9, being also shown. Figs. 7 and 8 represent clutches, and the three Figs. 6, 7, and 8 show the varying length of tooth of clutch relatively positioned. Fig. 9 is a detail view showing in section the roller-stop, which may be used instead of the pawl shown in Fig. 5. Fig. 10 shows in rear view a modification in construction, no ratchet in the upper differential wheel being shown, and a ratchet being shown in the wheel with a spring. Fig. 11 is a plan of Fig. 10, showing all the clutches of equal length or depth. Fig. 12 represents the differential wheels in section taken on line u u of Fig. 10. Fig. 13 illustrates partly in section the universal joint.

My improved motor has two side rods, D<sup>13</sup>, connecting four driving-wheels, D<sup>14</sup>, which are keyed onto two axles, and has four pedestals with journal-boxes and springs to support the frame A of the motor. On this frame A is placed a main shaft, B, and connected



with said shaft is an engine, P, which is intended to be run at a speed to be regulated by the governor O. Rigidly attached to the shaft B is the pinion I, which intergears with the idler I' and the wheel I<sup>2</sup>, the latter being keyed to the shaft I<sup>3</sup>, which is provided with the clutch G, that has a tooth, *g*. (See Fig. 3.) The tooth *g* engages with a similar tooth on a sleeve, *g'* on said shaft I<sup>3</sup>. The said sleeve *g'* is provided with a spring-pawl, G', Fig. 2, and mounted on the said sleeve is the wheel G<sup>2</sup>. In this wheel is placed the ratchet for the spring-pawl G'. The wheel G<sup>2</sup> engages with the wheel C, which is free to revolve on a shaft, D, and is provided with a fixed arm, C<sup>5</sup>, within which a ratchet-wheel, C', is keyed to said shaft between the arms of a yoke, C<sup>3</sup>, Fig. 2. The said yoke is connected with said shaft D and carries a pawl, C<sup>2</sup>, which is in position to connect with ratchet-wheel C'. C<sup>4</sup> indicates a rubber spring, which is carried by and between the arm C<sup>5</sup> and the yoke C<sup>3</sup>, both of which rotate with said wheel C. As before stated, the ratchet-wheel C' is keyed to shaft D, and by the construction shown when power is applied from the motor to wheel C such power is exerted through the spring C<sup>4</sup> to rotate the shaft D, said spring forming an elastic connection of the arm C<sup>5</sup> and the yoke C<sup>3</sup>. Thereby the power is applied elastically to the ratchet-wheel under elastic tension, as described in Patent No. 188,672, and from the shaft D to either the driving-wheels of the motor or the auxiliary traction devices, as hereinafter described. By the action of the ratchet and pawl the motor-shaft D is permitted to turn, so that the motor can roll ahead of the motive power of the motor, as in the instance of going downhill.

On one side of the motor power is transmitted from the shaft B through pinions I, I', and I<sup>2</sup> by means of the clutch G, which is provided with a tooth, *g*, to engage a tooth on the sleeve *g'*. This sleeve is provided with a pawl, G', Fig. 2, which operates in a recess in wheel G<sup>2</sup>, which is free to revolve on the sleeve *g'*, except when the pawl connects in said recess. The wheel G<sup>2</sup> connects with the wheel C, and thus power is communicated from shaft B to shaft D in the manner before stated, and by the wheels I, I', I<sup>2</sup> with the wheel C and ratchet-wheel C', for the purpose of a slow rate of speed, but with a high degree of traction-power.

On the other side of the motor the power-shaft B again operates through wheel I, and from thence through engaging-wheels K and K', the latter being fast on the shaft K<sup>2</sup>. On said shaft K<sup>2</sup> is a clutch, H, which is provided with a tooth, *h*, which connects with a similar tooth on a sleeve, *h'*. This sleeve is provided with a pawl, H', that is to connect in a recess formed in the wheel H<sup>2</sup>, Fig. 2. The wheel H<sup>2</sup> is of equal diameter with wheel K' and connects with wheel C, which imparts motion to the shaft D through an elastic connection, as before stated. The gearing last

described is for the purpose of a faster rate of speed than that obtained through wheel G<sup>2</sup>.

The upper wheel, B', is provided for the highest rate of speed of the motor. On the shaft B of said wheel is placed the clutch B<sup>2</sup>, which is provided with a tooth, *b*, to connect with a similar tooth on the hub of said wheel B'. The wheel B' may be constructed with the periphery-face or friction-face *b'*, Figs. 1 and 4, to engage with a similar face, *b*<sup>2</sup>, on the wheel C, or it may be provided with teeth, as seen in Figs. 2, 3, and 12. Said wheel B' may be provided with a sleeve, *b*<sup>3</sup>, Figs. 5 and 6, to connect with a tooth, *b*, and a pawl, B<sup>4</sup>, to engage with a ratchet formed within the hub of said wheel, so that the wheels B', H<sup>2</sup>, and G will have devices of like construction for the purpose of operating the pawls, as before stated. Instead of the said pawls a roller-stop, B<sup>5</sup>, Fig. 9, may be provided. Collars *b*<sup>4</sup>, *h*<sup>2</sup>, and *g*<sup>2</sup>, Figs. 3 and 6, are shown upon the sleeves, and are provided for the purpose of holding the wheels B', G<sup>2</sup>, and H<sup>2</sup> in their places on the sleeves.

When the wheels B' and C are provided with the friction-faces *b'* and *b*<sup>2</sup>, the pinion *c'*, Fig. 4, is made to face inward, the friction-face being on the large wheel C outside, as shown.

The teeth of the clutches G, B<sup>2</sup>, and H vary in length (see Figs. 3, 6, 7, and 8) and are operated or put in gear by means of the rods F<sup>2</sup>, connected with the rod F<sup>3</sup>, and by the clevises F<sup>4</sup>, F<sup>5</sup>, and F<sup>6</sup>, Fig. 3. The clutches are moved in and out of gear by the operator or driver of the motor simply pushing out the lever F, and, continuing by degrees to force out the said lever, imparts increased speed from the motive power to either the driving-wheels or the foot mechanism, or both, according to which is connected.

At the universal joint D<sup>2</sup> the pinion-wheels E and E' divide the power between the driving-wheels and the foot mechanism, and thus permit the whole power due to the differential wheels to be applied either to the feet E<sup>11</sup> alone or to the driving-wheels of the motor.

By the construction set forth the motive power of the motor is applied with yielding elastic tension either to the driving-wheels or to the feet, or to both at once, if desired, (this being an improvement on what is shown in Letters Patent No. 188,672, March 20, 1877,) and the ratchet C' in wheel C permits the driving-wheel to roll freely ahead at a higher speed than that applied by the motive power, as before explained.

The pinion-wheel E on the shaft D connects with the wheel E'. The wheel E' is provided with a pawl and ratchet, E<sup>2</sup>, as in the instance of the wheel B', Fig. 5, hereinbefore described, and by the said ratchet E<sup>2</sup> the feet are permitted to pull around the crank-axle by contact with the ground by operating the shaft E<sup>4</sup> by the beveled pinion E<sup>5</sup> of the crank-axle pulling around the clutch E<sup>2</sup> on shaft E<sup>4</sup>. The shaft E<sup>4</sup> is provided



with the beveled wheel E<sup>5</sup>, which engages with the wheel E<sup>6</sup>. This wheel is on the crank-axle E<sup>7</sup>, belonging to the foot device. This crank attaches by connecting-rod E<sup>8</sup> (shown in dotted lines in Fig. 1) to and on a slide and guide, E<sup>9</sup>, that is on the guide belonging to the frame of the motor, and at this point is also connected the pushing-leg E<sup>10</sup> of the foot E<sup>11</sup>. With the foot E<sup>11</sup> is connected the thrust-rod E<sup>12</sup>, which extends up and is connected, as shown, with the balance-beam E<sup>13</sup>, which vibrates on a bolt, E<sup>14</sup>. A counter-beam, E<sup>15</sup>, is also connected at this point, and to said counter-beam is attached a yoke, E<sup>16</sup>, which is provided with a powerful spring, E<sup>17</sup>. The yoke E<sup>16</sup> is connected with the beam E<sup>18</sup>, that is operated by toggle-joint links E<sup>20</sup> and a cam on the crank-axle E<sup>7</sup>. The clutch E<sup>3</sup> is drawn into gear by means of the lever E<sup>19</sup>, (shown in dotted lines,) connected by suitable connections with the lever R at the front of the platform D<sup>15</sup>. The mechanism last described forms an escapement equivalent to that shown in Letters Patent No. 381,847, of April 24, 1888.

The shaft D is held in journal D<sup>7</sup> to the central frame, L, of the motor. This frame also supports the wheels E, E', E<sup>5</sup>, and E<sup>6</sup>, with the connections which belong thereto. The said frame L also supports the universal joint D<sup>2</sup>, which is provided with a projecting arm, D<sup>10</sup>, and a recess into which the shaft D<sup>9</sup> extends. On shaft D<sup>9</sup> is a projecting arm, D<sup>11</sup>, which connects by a link, D<sup>12</sup>, with the arm D<sup>10</sup> of shaft D<sup>9</sup>. The shaft D<sup>9</sup> is also held by an arm, D<sup>8</sup>, which is attachable to and detachable from the driving-axle D<sup>5</sup>. This latter construction is also described in Letters Patent No. 381,847, of April 24, 1888. There are also provided journals D<sup>6</sup> and d, which are for the purpose of detaching the shaft D<sup>9</sup> from the arm D<sup>8</sup>, and journal D<sup>7</sup> is for the purpose of detaching the arm D<sup>8</sup> from the axle D<sup>5</sup>.

There are two bevel-pinions of the split or divided wheel construction, which are bolted on the axle D<sup>5</sup> with their teeth faced inward, and said pinions are keyed loosely on said axle D<sup>5</sup>, so that they may be moved in and out on that axle and in this manner be put in gear with the fixed pinion D<sup>3</sup> on the shaft D<sup>9</sup>. The motion of the pinion-wheel D<sup>3</sup> is in this manner given to either of the beveled pinions D<sup>4</sup>. This construction is for the purpose of the reverse action for the driving-wheels of the engine. When both wheels D<sup>4</sup> are pulled back out of gear, the two feet will alone control the traction of the motor. I do not intend to reverse the motive-power engine P of the motor. This engine is intended to run continuously in one direction and to be governed in its speed by a governor, O, which permits said engine to run continuously in one direction, notwithstanding the motor may be moved backward, and to do so necessitates the use of the two pinions D<sup>4</sup> for reversing the motor on the axle D<sup>5</sup>, as described.

The connecting-rods D<sup>13</sup> connect the driving-wheels D<sup>14</sup>, and the lever-man or driver

stands on the platform D<sup>15</sup>. The devices herein described may be applied to vehicles of any class for the purpose set forth.

In Figs. 10, 11, and 12 the power-shaft B has the pinion I arranged to operate a modification intended to gear with the pinion M, Fig. 10, which is keyed to the shaft m, and is provided with clutch M', to connect with a similar clutch belonging to the hub m' of the wheel N, which connects with the wheel C. On the other side of the motor the wheel I on shaft B connects with wheel K, which connects with wheel O', which is keyed on shaft o. The clutch o' is here provided to connect with the hub o<sup>3</sup> of wheel o<sup>2</sup>, which connects with wheel C. The shaft B is provided with a clutch, Q, to connect it with the hub q of the wheel B', as shown in Fig. 11.

The wheel B' connects with the wheel C, and, as will be seen, the ratchet-and-pawl connections, as seen in other figures, are here left out, leaving only the ratchet C' in the wheel C. The teeth m', q, and o<sup>3</sup> are all of the same length, and the clutches o', Q, and M' will have to be put in gear separately, as two clutches cannot be together in gear on shafts with wheels of different diameters and work or revolve to a common central wheel without providing the pawl or roller devices for permitting the fastest speed-wheel to slip and move the other devices. Without the pawl or roller two or more clutches used in this device would lock the wheels. Therefore I will use in this construction either the pawl or roller escapement for the purposes set forth.

I am aware that a device has heretofore been used for the purpose of obtaining two or more speeds on a traction-engine, as shown in English Patent No. 1,390 of 1882 and United States Patent to T. Blanchard, December 28, 1825.

I claim—

1. In a traction-motor, a driving-axle provided with flanged driving-wheels keyed thereto, with sliding pinions and fixed central collar, combined with a removable arm provided with a removable intermediate shaft which is provided with a universal coupling connecting it with the driving-shaft of the motor, said driving-shaft having an elastic connection with the operating mechanism, substantially as and for the purposes described.

2. In a traction-motor, a driving-axle provided with flanged driving-wheels keyed thereto, with sliding pinions and fixed central collar, combined with a removable arm provided with a removable intermediate shaft which is provided with a universal coupling connecting it with the driving-shaft of the motor, which shaft has an elastic connection with the differential wheels provided with escapement devices, whereby the speed of the motor may be changed, substantially as and for the purposes set forth.

3. In a traction-motor, a driving-axle pro-



vided with flanged driving - wheels keyed thereto, with sliding pinions and fixed central collar, combined with a removable arm provided with a removable intermediate shaft 5 which is provided with a universal coupling connecting it with the driving-shaft of the motor, which shaft has an elastic connection with the differential wheels provided with friction and escapement devices, whereby the 10 speed of the motor may be changed, substantially as described, for the purposes set forth.

4. In a traction-motor, the carrying-wheels and auxiliary traction devices other than said carrying-wheels, in combination with the differential wheels provided with the escape- 15 ment-pawl, substantially as and for the purposes described.

5. In a traction-motor, the combination, with the feet and driving-wheels, of the elastic escapement-wheel C, the shaft D, and device 20 adapted to operate either the foot mechanism or the driving-wheel mechanism, substantially as and for the purposes set forth.

6. In combination with a driving-shaft, a

wheel provided with a fixed arm, a yoke within 25 said arm and loose on said shaft, a ratchet-wheel keyed to said shaft and provided with a pawl, and an elastic connection between said fixed arm and said yoke, for the purposes specified. 30

7. In a traction-motor, the operating-shaft provided with an elastic connection and escapement, C, and the differential wheels provided with escapement devices, whereby the 35 speed of the motor may be changed, substantially as and for the purposes set forth.

8. In a traction-engine, a universal joint, D<sup>2</sup>, having a central opening for the end of a shaft, and the shaft D<sup>9</sup>, provided with arms D<sup>10</sup> D<sup>11</sup>, connected by a link, D<sup>12</sup>, substantially as 40 and for the purposes set forth.

In testimony whereof I affix my signature in presence of two witnesses.

BENJAMIN CHARLES POLE.

Witnesses:

H. J. TAYLOR,  
ROBERT E. MORRIS.